Neutron Stars in Supernova Remnants
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The X-ray sources at the center of G266.1–1.2

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Abstract. We present optical observations of the fields of two X–ray sources located near the center of the shell-like supernova remnant G266.1–1.2. No objects brighter than R∼22.5 and B∼23 are present within the small *Chandra* error region of AX J0851.9–4617.4 , besides a R∼17 star that has already been excluded as a possible counterpart. A bright diffuse H_α nebula is present close to the position of the candidate neutron star.

1. Introduction

The supernova remnant G266.1–1.2 has been reported as a possible γ-ray source in the 1.156 MeV line of ^{44}Ti (Iyudin et al. 1998). The short lifetime (∼90 yrs) of this isotope, and the relatively small angular size of the remnant would imply an age of only ∼680 years and a small distance d∼200 pc (Aschenbach et al. 1999). Thus G266.1–1.2 could be the remnant of the closest supernova event to have occurred in recent historical times.

However, *ASCA* observations showed that the X–rays from the SNR shell have a non-thermal spectrum and the fits require a high absorption value (Slane et al. 2001), favoring a distance of ∼1-2 kpc that would place G266.1–1.2 well beyond the Vela SNR (see also Mereghetti & Pellizzoni 2001). The *ASCA* data revealed also a central point source, AX J0851.9–4617.4 , surrounded by diffuse X–ray emission, that was interpreted as the neutron star associated to G266.1–1.2.

A *BeppoSAX* observation (Mereghetti 2001) of the central region of G266.1–1.2 showed the presence of a second source about $3'$ north of that detected by *ASCA* and with a harder spectrum. The northern source was named SAX J0852.0–4615. Since the *BeppoSAX* error circle of AX J0851.9–4617.4 contained two bright early type stars that might have produced the observed X–ray flux, while no optical counterparts brighter than V∼15 were visible for SAX J0852.0–4615 , it was unclear which of the two sources was the most likely neutron star candidate.

The puzzle has been recently solved by a *Chandra* observation that provided an arcsecond position for AX J0851.9–4617.4 (Pavlov et al. 2001). The new error box is incompatible with the two early type stars that were previously considered as possible counterparts, thus confirming that AX J0851.9–4617.4 is the most likely neutron star candidate. SAX J0852.0–4615 was not detected in the 3 ks long *Chandra* observation reported by Pavlov et al. (2001). This might be due to variability, or to the hardness of this source, that was detected with *BeppoSAX* only above 5 keV. A deeper observation with *XMM-Newton*

confirmed the existence of SAX J0852.0–4615 , with a flux about ten times fainter than that of AX J0851.9–4617.4 (Aschenbach, this conference).

Here we present optical observations of the fields of these two X–ray sources.

2. Optical observations of the field of AX J0851.9–4617.4

Optical images of the central region of G266.2–1.2 were obtained through the public archive of the European Southern Observatory (ESO). These data consist of images in the R and B bands taken with the Wide Field Imager instrument at the La Silla 2.2m telescope on July 30, 1998. We derived an approximate calibration of these data based on a number of stars of the USNO catalogue.

Figure 1 shows the R band image of the *BeppoSAX* error region ($1'$ radius) of AX J0851.9–4617.4 . The two early type stars that were previously considered as possible counterparts are the B8 type star HD76060 (V=7.9), and Wray 16-30, a B[e] star with V=13.8 (Thé et al. 1994) also detected with IRAS.

The small circle indicates the new position of AX J0851.9–4617.4 determined with *Chandra* (Pavlov et al. 2001). No objects, down to limits of R$\sim$22.5 and B$\sim$23 are present at the *Chandra* position, besides a star with R$\sim$17 on the edge of the error circle. As discussed by Pavlov et al. this object is probably a late type star and cannot be the counterpart of the X–ray source.

Some diffuse emission is also visible to the West of the *Chandra* position. This nebula is better seen in the H_α image shown in Fig.2. The brightest part of the H_α nebula has a roughly elliptical shape with dimensions $\sim 40'' \times 20''$, and a sharply defined western edge. Some nearly parallel filaments are also visible, one of which seems to be composed by a series of aligned bright spots (see Fig.1).

3. Optical observations of the field of SAX J0852.0–4615

The field of the northern source, SAX J0852.0–4615 , is shown in the R band image of Fig.3. The brightest stars in the *BeppoSAX* error region ($1'$ radius) have R$\sim$15, implying a ratio of X–ray to optical flux $F_x/F_{opt}>0.1$. None of the stars in the error region has particularly unusual colors.

4. Conclusions

The deep optical limits for the possible counterparts of AX J0851.9–4617.4 confirm that this is most likely the neutron star remnant associated with G266.1–1.2.

An interesting H_α nebula has also been discovered in the data presented here. Emission in the H_α has been detected around a few radio pulsars and is thought to originate in the interstellar medium shocked by the relativistic pulsar wind. These nebulae have either a "cometary" shape with the axis of symmetry along the direction of the pulsar transverse motion (e.g., PSR B2224+65 ("Guitar Nebula", Cordes et al. 1993) or PSR B0740–28 (Stappers et al. these proceedings)) or an arc-like shape (e.g., PSR J0437–4715, Bell et al. 1996).

The morphology of the diffuse emission shown in Fig.1 and Fig.2 does not present any obvious connection with the location of the candidate neutron star as determined with *Chandra*. It is more likely that the nebula is related to the B[e]

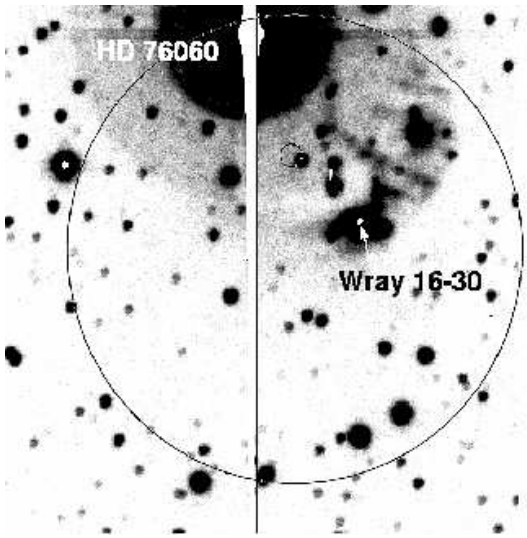

Figure 1. Image in the R band of a $2' \times 2'$ region around the position of AX J0851.9–4617.4 . The exposure time is 5 minutes. North is to the top, East to the left. The circle with $1'$ radius is the *BeppoSAX* error region, while the small circle indicates the *Chandra* position derived by Pavlov et al. (2001).

Figure 2. The same region of Fig.1 imaged in the H_α filter with the EMMI instrument on the ESO NTT telescope (exposure time 600 s).

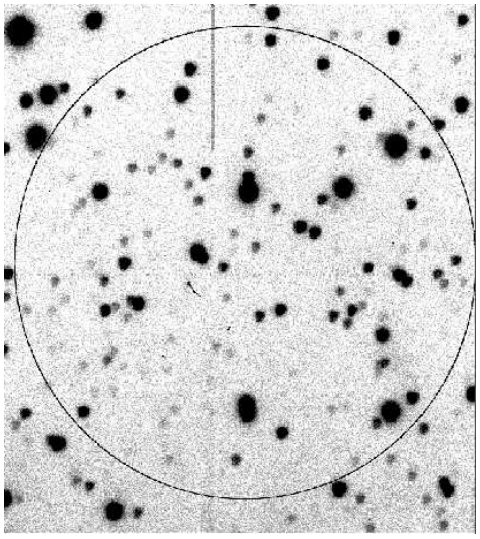

Figure 3. Image in the R band of a $2' \times 2'$ region around the position of SAX J0852.0–4615 . The exposure time is 5 minutes. North is to the top, East to the left. The circle with $1'$ radius is the *BeppoSAX* error region.

star Wray 16-30, which is located at the southern end of the nebula. However, its peculiar morphology and the location close to the center of G266.1–1.2 make this nebula a potentially interesting target for more detailed investigations.

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References

Aschenbach, B., Iyudin A.F., & Schönfelder V. 1999, A&A, 350, 997

Bell J.F. et al. 1995, ApJ, 440, L81

Cordes J.M., Romani R.W. & Lundgren S.C. 1993, Nature, 362, 133

Iyudin A.F. et al. 1998, Nature, 396, 142

Mereghetti S. 2001, ApJ, 548, L213

Mereghetti S. & Pellizzoni A. 2001, in Proc. GAMMA 2001, S.Ritz, N.Gehrels & C.R.Shrader eds., AIP Conf. Proc. n.587, 523

Pavlov G.G., Sanwal D., Kiziltan B. & Garmire G.P. 2001, ApJ, 559, L131

Slane P. et al. 2001, ApJ, 548, 814

Thé P.S., de Winter D. & Perez M.R. 1994, A&AS, 104, 315